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Endoluminal Angioplasty of the Popliteal Artery. Review of 54 Consecutive Patients

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Aim. *To determine the results of endoluminal angioplasty for occlusive or stenotic lesions of the popliteal artery.*
Methods. *Retrospective study of symptomatic patients having popliteal occlusive lesions treated by endoluminal balloon angioplasty. All patients underwent systematic preoperative and postoperative color duplex scan and preoperative angiography. The principal endpoints were primary and primary assisted patency.*
Results. *Fifty-four percutaneous endoluminal angioplasties of the popliteal artery, including six procedures with stents, were performed in 50 patients. In all cases, the superficial femoral artery was patent and without significant stenosis. Primary patency for the entire cohort was 57.4±6.7% at 1 and 2 years. Primary assisted patency was 86.3±4.8% at 1 year, and 79.1±5.9% at 2 years.*
The results of angioplasty appeared to be better in patients with intermittent claudication when compared to patients with critical limb ischaemia, (p=0.0006). Angioplasty of single occlusive lesions had a better prognosis than that of multiple occlusive lesions (p=0.01). Results of angioplasty were better at the below-knee and median popliteal artery than at the femoro-popliteal junction or in the above-knee popliteal artery (p=0.03). Tibial run-off and isolated popliteal stenosis versus *isolated popliteal thrombosis did not seem to affect primary patency rate.*
Conclusion. *Results of angioplasty of the popliteal artery are acceptable for claudicants, especially those with TASC-A lesions and those with lesions in the distal two thirds of the popliteal artery.*

Keywords: Balloon dilatation; Popliteal artery; Stenosis; Primary patency; Primary assisted patency.

Introduction

The results of endoluminal angioplasty of the popliteal artery have rarely been studied specifically. In most cases, authors have studied the results of angioplasty of the superficial femoral artery with that of the popliteal artery.[1–3] Only two studies focusing specifically on angioplasty of the popliteal artery can be found in the literature. The first, performed by Steinkamp[4] concerned 215 cases, and compared the results of endoluminal angioplasty with a balloon catheter with those of laser endoluminal angioplasty. The second study, performed by Strecker,[5] evaluated the efficacy of flexible tantalum stents in treating residual stenoses after angioplasty of the popliteal artery. In most studies, results have focused on angioplasty for the entire femoral and popliteal segment: In this setting, primary patency rate, varies from 22 to 81%, after 1-year follow-up. The aim of our study was to determine the 2-year results of endoluminal angioplasty for occlusive lesions limited to the popliteal artery.

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Methods

This was a retrospective study of 50 patients having 54 popliteal angioplasties between January 1997 and April 2002. All these patients were symptomatic with intermittent claudication (IC=26) or critical limb ischemia (CLI=28). All patients had an occlusion or a significant stenosis of the popliteal artery. Before treatment, all patients had a duplex ultrasonography, with colour imaging, and angiography of the lower limbs. Lesions were classified according to TASC criteria. Patients excluded from the study were those presenting with acute ischemia. In contrast, patients presenting with a simultaneous significant stenosis of the iliac or common femoral artery, were included in the study. Percutaneous transluminal angioplasty (PTA) was performed by a vascular surgeon in the operating room, using a conventional guidewire and angioplasty balloon catheter technique without

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thrombolysis or aspiration. During the procedure, each patient was given 50 IU/kg of heparin intravenously and if tolerated 160 mg aspirin daily thereafter. Postoperative criteria of success was defined: By relief or substantial improvement of claudication with an increase in walking distance by at least 50%, resolution of rest pain and limb salvage in patients with tissue loss. Patency was determined by duplex scan, performed routinely at 1, 6, 12 months after surgery and every year thereafter. Special emphasis was given to the site of angioplasty to detect any occlusion or significant restenosis with cross sectional area reduced by 70% or more. Angiograms were performed whenever significant restenosis or occlusion was seen by duplex. Ankle-brachial index was not obtained routinely. Failure of angioplasty was defined by persistence or recurrence of a significant popliteal stenosis by duplex scan, with or without worsening of clinical symptoms. Analysis of primary patency and primary assisted patency, was undertaken considering the following parameters: Preoperative symptoms, TASC classification (A, B, C) in the femoro-popliteal segment, and existence of single or multiple lesions, length of the lesion, thrombotic or stenotic lesion, location of the lesion on the popliteal artery, above knee, below knee or retroarticular. Finally, tibial run-off (number of patent arteries in the leg) was analysed. The Kaplan–Meier method was used to calculate the cumulative patency rate for individual variables and subgroups. The survival curves were compared by the log rank (Mantel–Cox) test.

Results

The clinical characteristics of these patients are shown in Table 1. Fifty-four endoluminal angioplasties of the popliteal artery were performed in 50 patients having 65 occlusive lesions (Table 2). Forty-four patients had a single occlusive lesion and 10 patients had multiple occlusive lesions, with two popliteal stenoses in nine patients, and three popliteal stenoses in one patient. Forty patients underwent angioplasty and 14 patients underwent recanalisation (the median length of occlusion in this series was 2.5 cm (range 0.5–8 cm)). Ultra thin angioplasty balloons (Boston Scientific) were used in all cases, the diameter of the balloon was 4 mm in 27 cases (41%) and 5 mm in 29 cases (45%). We also used 3 mm balloons twice (3%) and 6 mm balloons seven times (11%). Three haematomas occurred at the puncture site with one false aneurysm. Per-operative mortality was nil. Following initial angioplasty, we observed nine residual stenoses, from 20 to 50%, that were left untreated with one significant restenosis (11%) at 1 year. Follow-up was for 2 years in all patients. Two major amputations were needed during the first year in patients with critical limb ischemia (CLI), and two failures (4%) were treated by femoropopliteal or tibial bypass. Five concomitant lesions of the iliac or common femoral artery were treated, i.e two iliac angioplasties, two common femoral endarterectomies, and one ilio-femoral bypass. Three of these patients remain asymptomatic, one patient had a popliteal restenosis and one patient died during follow-up. In addition, two infrapopliteal lesions were treated simultaneously: One patient remains asymptomatic and one patient had a recurrent popliteal stenosis at 1 year. The primary patency rate, for the entire cohort was $57.4 \pm 6.7\%$ at 2 years. Primary assisted patency rate was $86.3 \pm 4.8\%$ at 1 year, and $79.1 \pm 5.9\%$ at 2 years. Four patients (8%) were lost to follow-up (three patients by 1-year and one by 2 years). Eleven patients (22%) died during follow-up. Among the 13 patients with a restenosis, primary assisted patency after repeated angioplasty was 69%, (six patients underwent two angioplasties, one patient underwent three consecutive angioplasties and two patients a bypass). Six nitinol self-expanding stents were used, two to treat a restenosis and four to treat a popliteal dissection during the initial procedure. These stents were positioned at the level of the upper popliteal artery. No stents were positioned in middle popliteal artery or lower popliteal artery. Five stents remain patent during follow up and one stent had occluded by 1 year.

Primary patency at 2-year was higher in patients with intermittent claudication ($87.0 \pm 7.0\%$) than in patients with critical limb ischemia ($38.2 \pm 10.8\%$) $p = 0.0006$ (Fig. 1). TASC type A lesions appeared to have a better patency ($73.4 \pm 7.6\%$) than type B–C lesions ($40.4 \pm 13.4\%$) $p = 0.09$. Angioplasty of single occlusive

Table 1. Patients and popliteal lesions characteristics

Characteristics	Patients (%)
Male	34 (68)
Risk factors	
Diabetes	24 (48)
Hypertension	27 (54)
Dyslipidemia	11 (22)
Current smokers	13 (26)
Ischemic heart disease	15 (30)
History of vascular disease	7 (14)
ASA classification	
ASA 1	2 (4)
ASA 2	17 (34)
ASA 3	28 (56)
ASA 4	3 (6)
Age	73 years (48–93)
Length of popliteal lesion	12 mm (2–80 mm)

Table 2. Patency at 2-year according to the patient or lesion characteristics

	n	%	Primary patency rate ± SE	*p* Value*
Indications				
Intermittent claudication	26	48	87.0 ± 7.0	
Critical limb ischemia	28	52	38.2 ± 10.8	0.0006
TASC popliteal classification				
Type A	36	67	73.4 ± 7.6	
Type B–C	18	33	40.4 ± 13.8	0.09
Number of lesions				
Isolated	44	81	71.7 ± 7.3	
Multiple	10	19	26.7 ± 16.0	0.01
Anatomical location				
Median and BK popliteal	37	57	77.6 ± 8.1	
AK popliteal	28	43	41.5 ± 9.1	0.03
TASC infrapopliteal lesions				
Type B	11	20	77.8 ± 13.9	
Type D	43	80	60.2 ± 8.1	NS
Type of isolated lesion				
Stenosis	31	70	75.1 ± 8.2	
Thrombosis	13	30	64.6 ± 14.3	NS
Length of lesion (cm)				
<3	59	91	59.1 ± 7.0	
≥3	6	9	41.7 ± 22.2	NS

Primary patency rate for the entire cohort was 57.4 ± 6.7% at 2-year. BK, below knee; AK, above knee; NS, non-significant.
* Log rank test.

lesions had a better primary patency rate at 2-year (71.7 ± 7.3%) than that of multiple occlusive lesions (26.7 ± 16.0%) $p = 0.01$. Angioplasty produced better results in the lower and middle popliteal artery (77.6 ± 8.1%) than at the femoropopliteal junction or in the upper popliteal artery (41.5 ± 9.1%) $p = 0.03$. However, length of lesions, tibial run-off and stenoses compared to occlusion, did not influence primary patency rate.

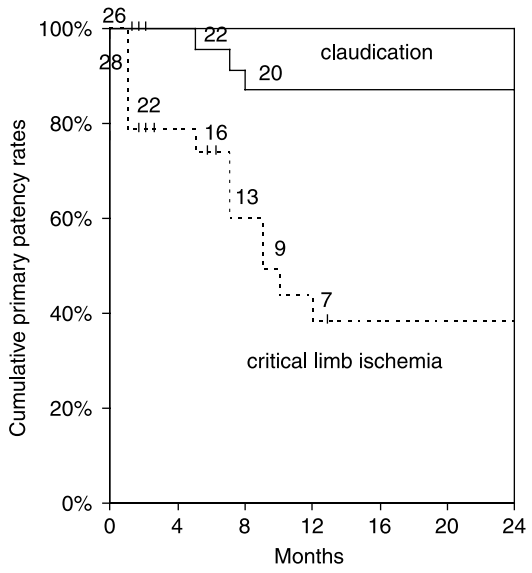

Fig. 1. Cumulative primary patency rate (Kaplan–Meier method) for 26 patients with intermittent claudication and 28 patients with critical ischaemia having angioplasty of the popliteal artery. Numbers indicate patients at risk at each time interval.

Discussion

Angioplasty of the popliteal artery remains controversial. Many questions remain concerning its intrinsic value, including indications and prognostic factors influencing long-term patency. The length of occlusive lesions is apparently a significant factor affecting primary patency. However, the definition of a short lesion varies from one report to another; it may be less than 2 cm, 3 cm, even 5 or 7 cm and sometimes 10 cm. This criterion was not significant in our series, but most lesions were less than 3 cm with a mean length of 1.2 cm. It is important to note that several authors have used fibrinolysis to reduce the length of occlusive lesions.[1,2,6–10] Strecker[5] evaluated the efficacy of flexible tantalum stents in the popliteal artery in 32 patients, for the treatment of residual stenoses of more than 50% after angioplasty for stenosis (17 cases) and thromboses (15 cases) of the popliteal artery. Strecker[5] reported primary patency rates at 1 and 2 years of 81 and 74%, respectively. In this series,[5] primary patency rate at 1 year was better for stenoses than for occlusions; however, this difference was not significant. In keeping with the results of Albäck, Cormier and Henry,[3,11,12] we did not find in our series any significant difference between these two groups. Henry[3] found that restenosis was more common in the distal third of the superficial femoral artery (SFA) and in the popliteal artery as compared with the proximal two-thirds of the SFA. We found that below knee and retroarticular popliteal arteries were more suitable for an endovascular procedure than above

knee popliteal artery and had a better patency rate. From our series, we can conclude that angioplasty of the femoropopliteal segment is acceptable, with best results at the distal two-thirds of the popliteal artery. This finding might be explained by a reduced mobility following knee flexion of the artery at this level compared with the upper politeal artery.

There is no consensus regarding the use of popliteal angioplasty to treat claudication, but even if PTA is a commonly performed procedure at this level, Perkins[13] failed to show any significant benefits from angioplasty in a controlled trial comparing exercise training to angioplasty. Therefore, Perkins[13] recommends exercise training as initial management in stable claudicants with multifocal stenosis of the superficial femoral artery. In contrast, Whyman[14] found that PTA in patients with claudication due to single short superficial femoral artery stenosis offered a better short term outcome than best medical treatment alone. It is true that improvement in symptoms with exercise is common but improvement may not show for up to a year, whereas improvement of symptoms after a successful angioplasty can be immediate.

Our results show that PTA is an interesting alternative to open surgical revascularization, for short TASC A lesions, with an acceptable patency rate at medium term follow-up. However, this endovascular approach should be used with caution, because of the risk of worsening of the symptoms in the event of failure.[12,15]

For treatment of critical limb ischemia, the primary patency rate in our series was only $38.2 \pm 10.8\%$ at 2 years. However, only half of these patients had TASC type A lesions, the other half had type B–C with extensive or multiple lesions.

It is logical that the results of angioplasty should be influenced by the type and severity of the occlusive lesion. This has been confirmed by several studies of femoro-popliteal stenting.[1,10,11,16] In our series, the patency at 2 years was significantly better for single stenoses ($71.7 \pm 7.3\%$) than for multiple stenoses ($26.7 \pm 16.0\%$). In contrast, we did not show any difference in patency rates following the treatment of either isolated short thromboses or stenoses.

Conclusions

Angioplasty of the popliteal artery is a simple technique which merits further evaluation. It could become the technique of choice for TASC A lesions of the distal two thirds of the popliteal artery in patients with intermittent claudication. However, angioplasty cannot be recommended in patients with multiple stenoses, located at the level of the femoropopliteal junction and upper popliteal artery or for patients with TASC B–C lesions.

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